IV. Spectrum Measurements

A. Runs Made at Each Frequency Band

This section contains plots of the measured data. For each spectrum band, multiple, one-hour long runs were made with different equipment configurations. The runs made for signal below 1000 MHz are shown in Table 7. These multiple runs were used to determine what noise was caused by the ambient sources and what was caused by undesired leakage from the spectrum measurement system. The run made for signals between 1,000 MHz and 3,000 MHz is shown in Table 8. Another run with a non-rotating antenna was made, but was later found to be invalid because of a broken RF filter.

Table 7 Measurement Runs Made Below 1,000 MHz

Configuration	Reason
Omni-directional antenna, pre-amplifier, located at NSF	Configuration of interest.
Omni-directional antenna, pre-amplifier, located at an RF quiet location	To provide a noise-level baseline caused by the self generated noise from the spectrum collection equipment.
Rotating, directional antenna, without pre-amplifier at NSF	To determine if a single or multiple transmitters existed and to provide an approximate signal angle of arrival if a single transmitter case. The pre-amplifier was not used to also check if there was an RF signal overload problem.

Table 8 Measurement Runs Made Above 1,000 MHz

Configuration	Reason
Rotating, directional antenna, with pre-amplifier at NSF	Configuration of interest.

B. Description of Spectrum Plots

In each figure, there are two plots for each spectrum band. The upper plot has three subplots. The upper sub-plot is the maximum power value versus frequency measured during the period. The power values are the levels at the antenna port and are corrected for cable losses, filter losses, and amplifier losses. The time shown on the plot is the measurement start time.

The middle sub-plot is a waterfall-type plot with occupancy plotted versus time and frequency. Occupancy is determined when the power level exceeds a threshold. The threshold value was hand-selected for each run, and is shown as a dotted line on the upper sub-plot. In some cases, the noise level exceeds the threshold, causing inflated occupancy levels. To correct this, the threshold would have to be hand-selected for each plot, which was not done. Figure 19 is annotated to illustrate the above description.

The last sub-plot is the fraction of time the signal is on versus the frequency measured during the period. If the fraction of time is ‘1’ it means the signal was on for all the measurement time and vice versa.

The lower plot is a three-dimensional mesh plot with ‘X’ and ‘Y’ axes as frequency and time respectively and ‘Z’ axis is received signal level in dBm.

C. Data Issues/Comments

1. 30 MHz to 50 MHz

Wide band noise at 45 MHz was measured at the Riverbend Park location. This was probably due to the gas generator, which was not present at the NSF location.

2. 88 MHz to 108 MHz

The high noise level in this band is an artifact of the calibration process. An FM bandstop filter was used, which increased the RF loss and caused the system noise to artificially be increased post-calibration.

3. 108 MHz to 138 MHz

The increase in the background noise level is clearly seen in the 108 MHz to 118 MHz portion of the band because of the lack of signals.

4. Intermittent Broad Bandwidth Noise

Broad bandwidth, intermittent noise was observed from 2700 seconds until 3000 seconds from the start of the NSF observation at frequencies from 512 MHz to 806 MHz. This is shown in Figure 31, Figure 34, and Figure 37. The building's HVAC equipment was intermittently operating and may have been the cause.

D. Measurements Made Below 1,000 MHz

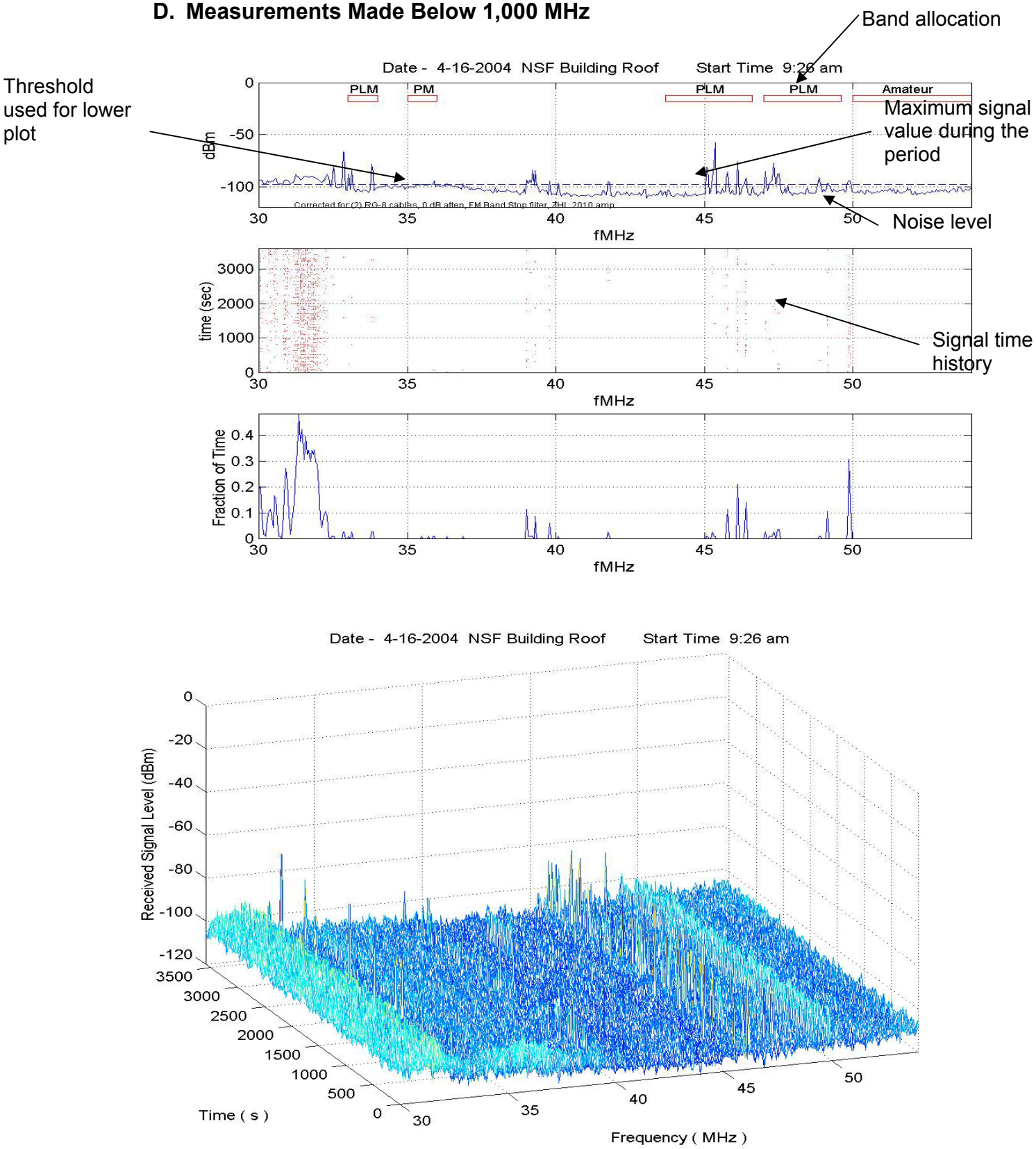
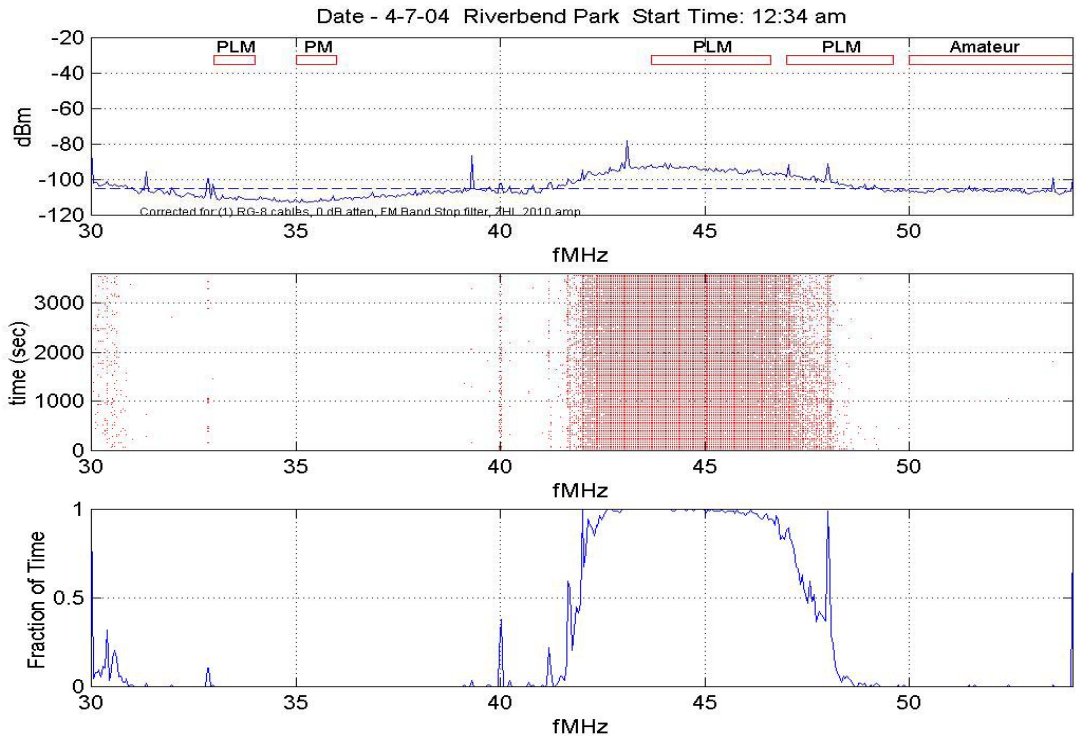


Figure 19: 30 MHz to 54 MHz (Antenna Not-Rotating, NSF).



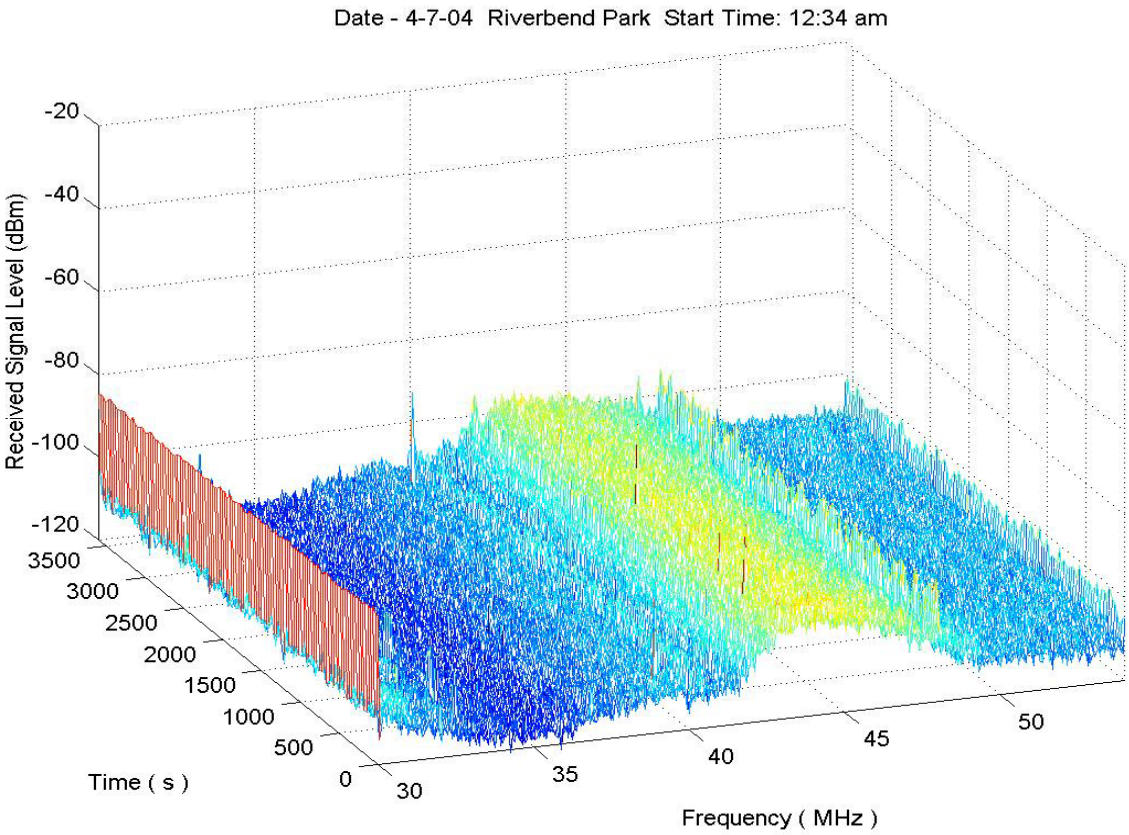
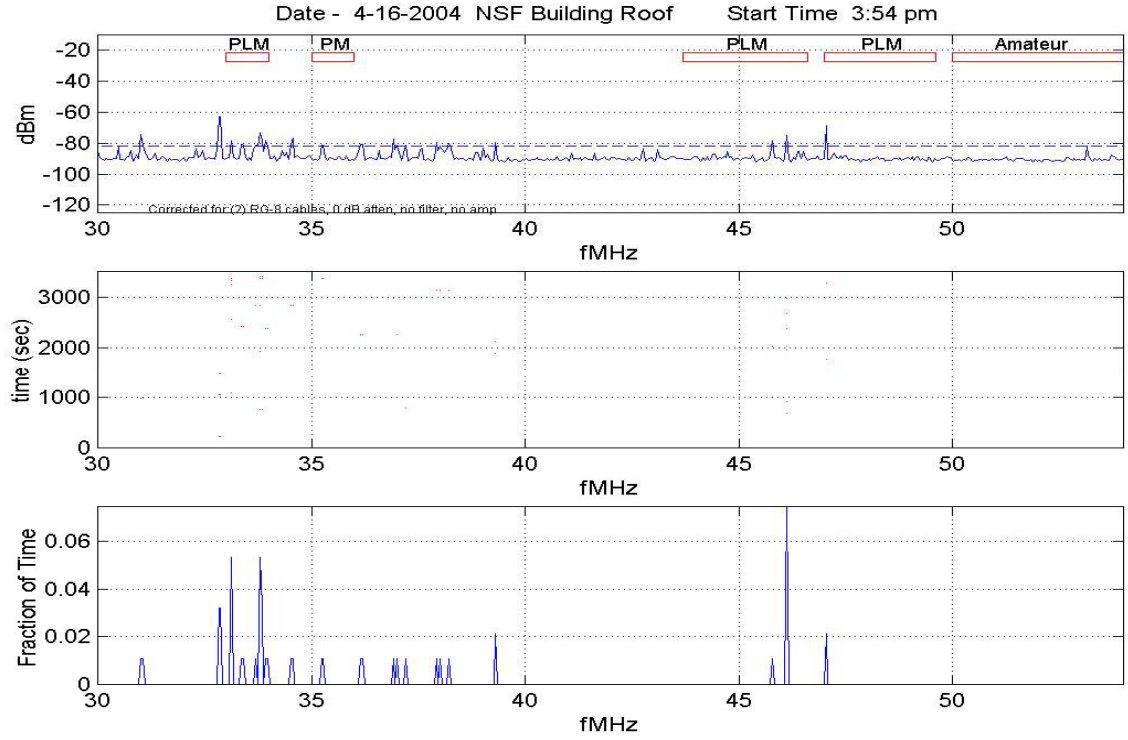


Figure 20: 30 MHz – 54MHz (Antenna Not-Rotating, Riverbend Park)



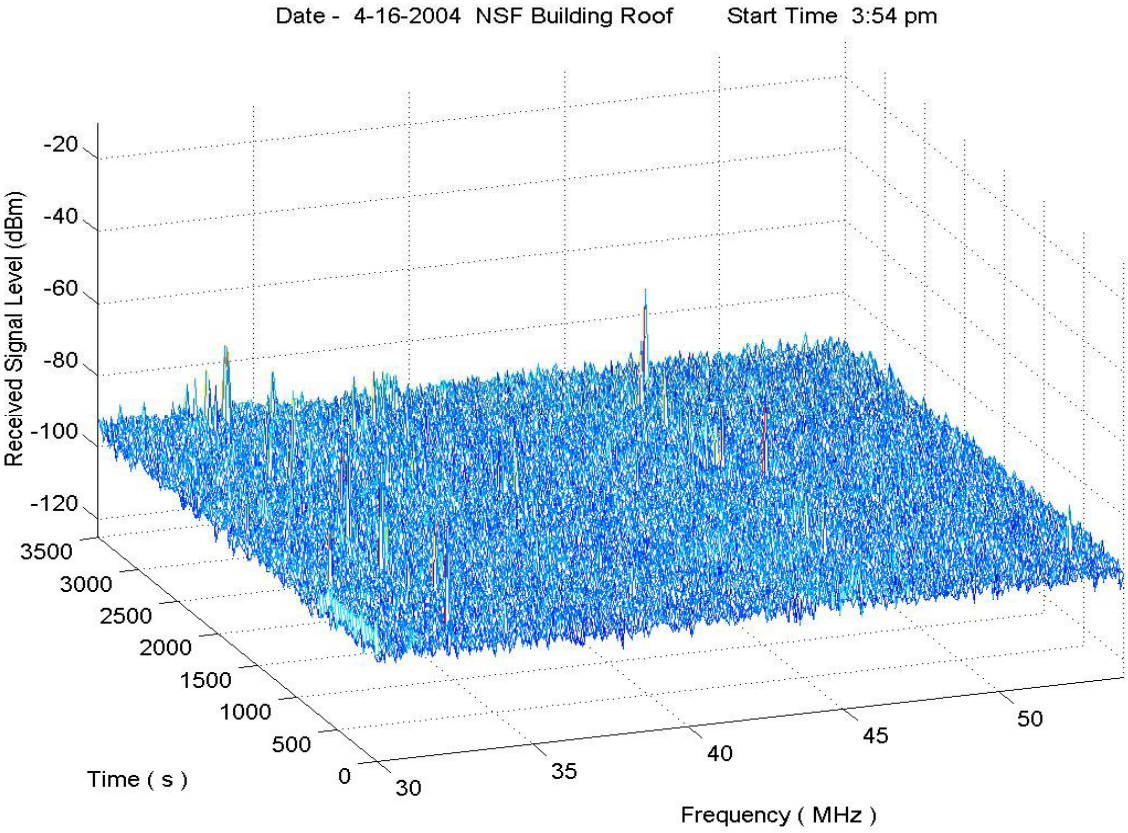
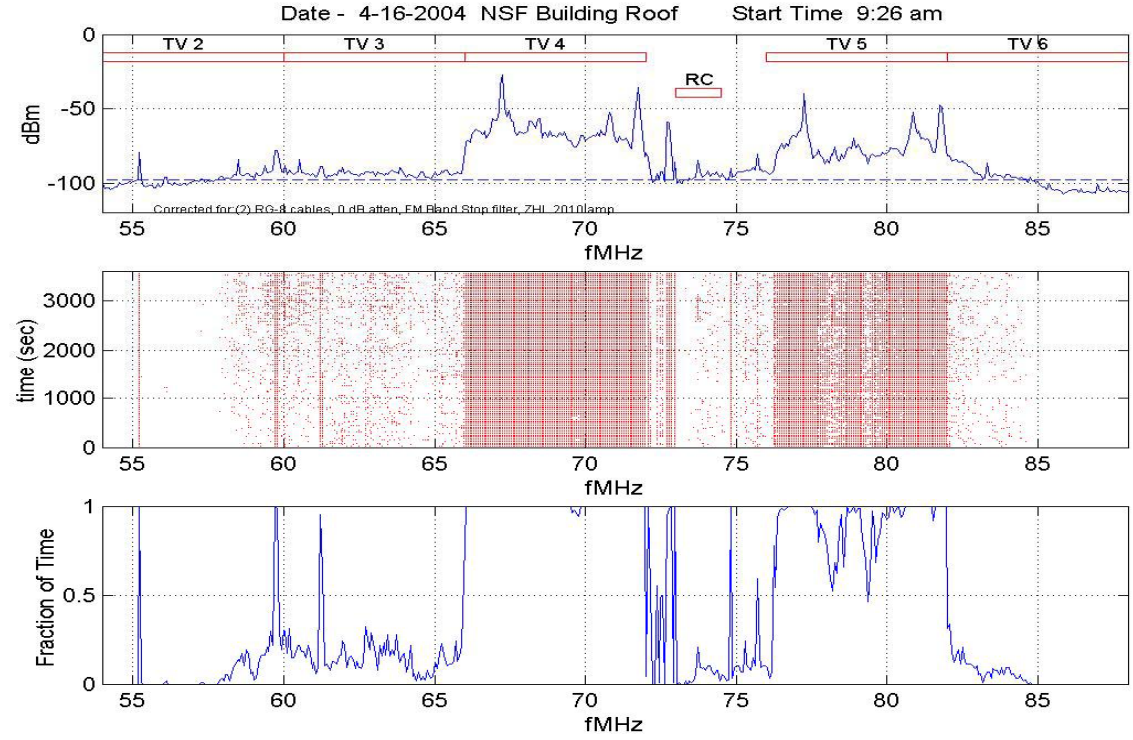


Figure 21: 30 MHz – 54 MHz (Antenna Rotating, NSF)



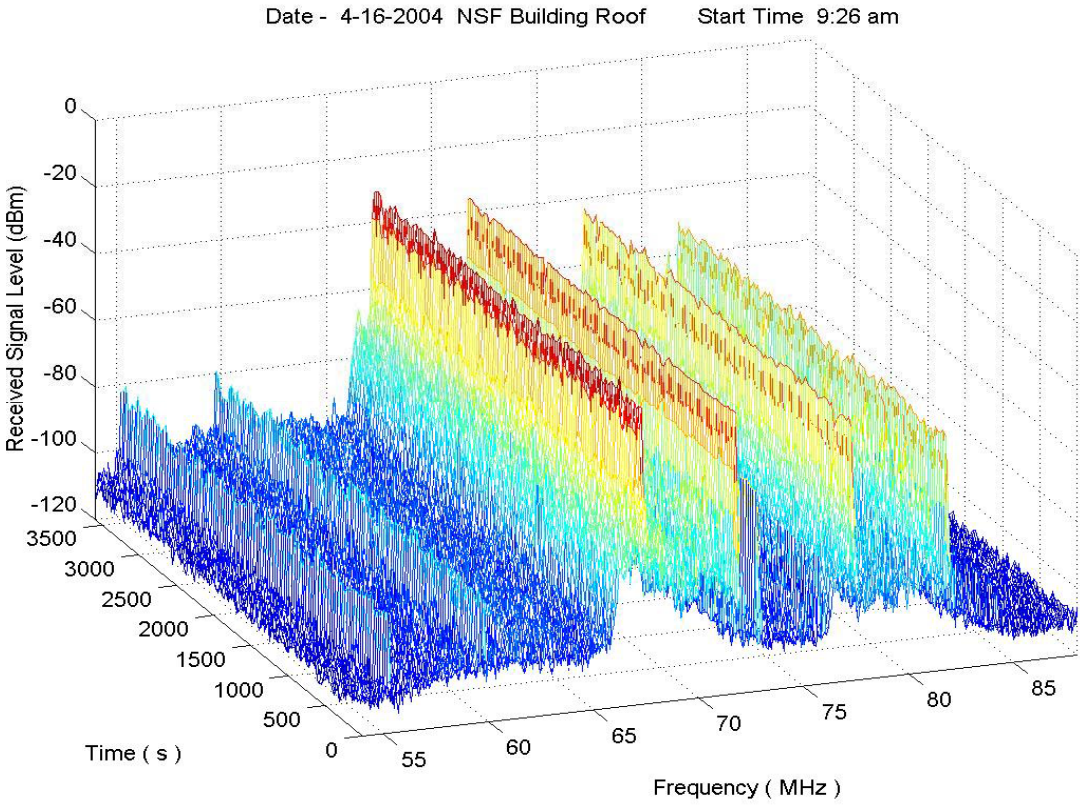
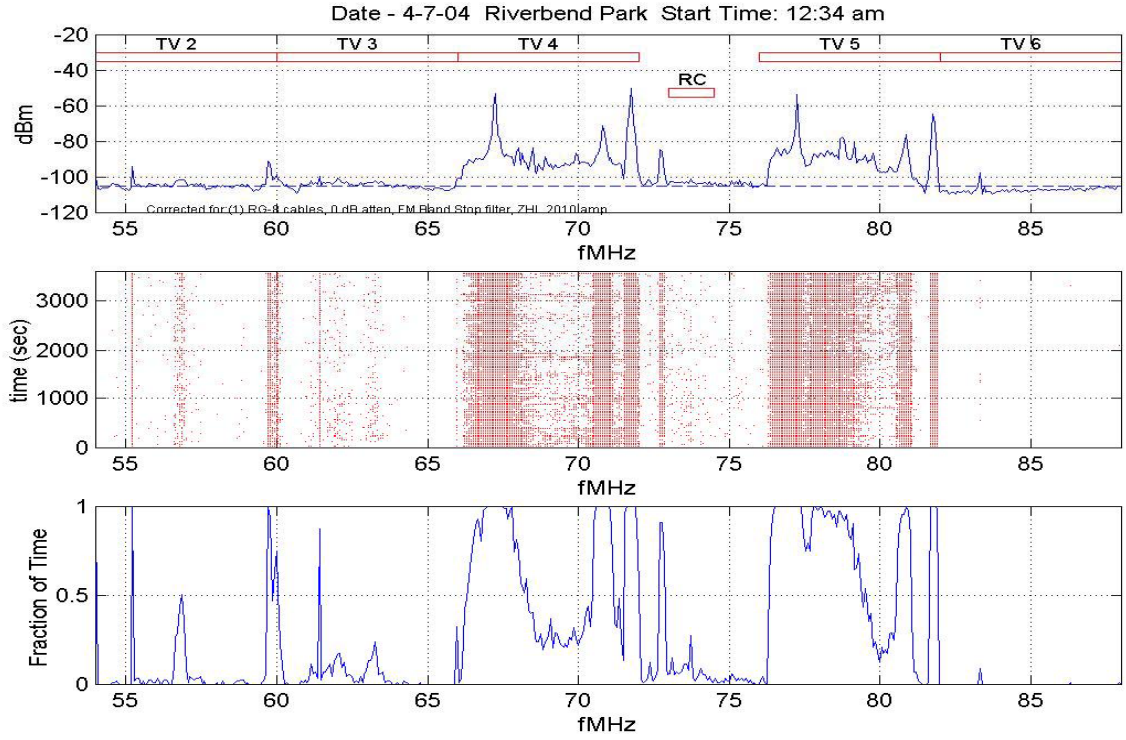


Figure 22: 55 MHz – 88 MHz (Antenna Not- Rotating, NSF)



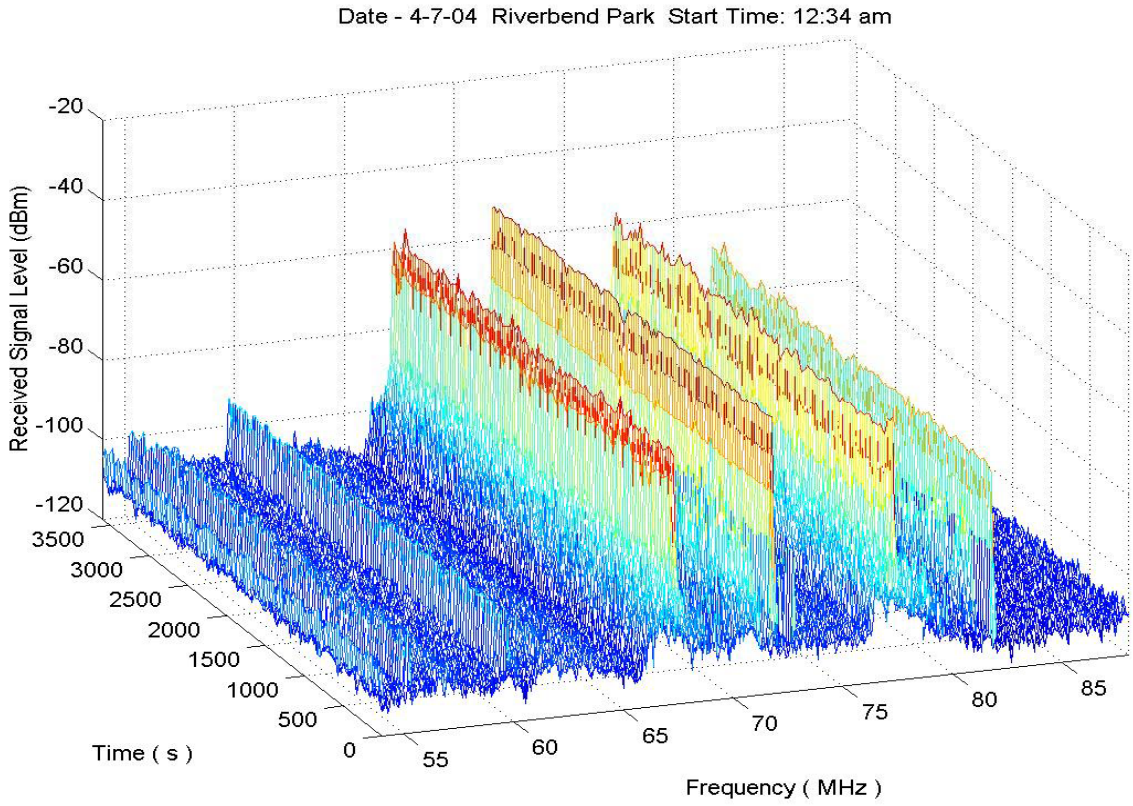
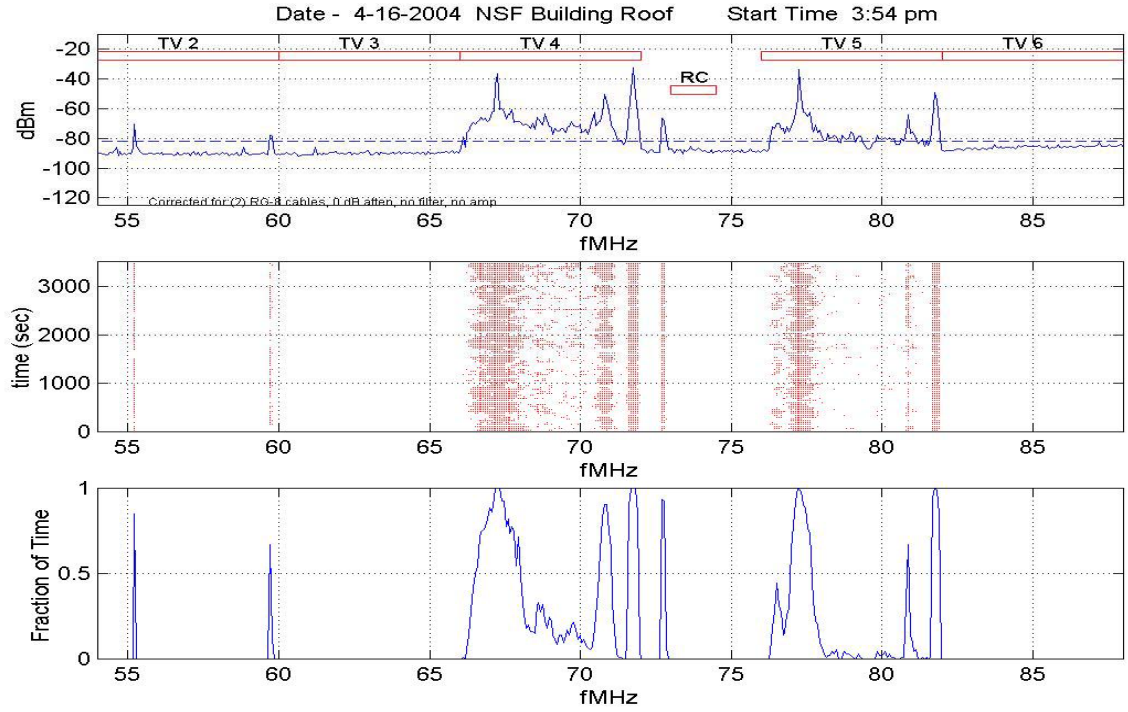


Figure 23: 55 MHz – 88 MHz (Antenna Not-Rotating, Riverbend Park).



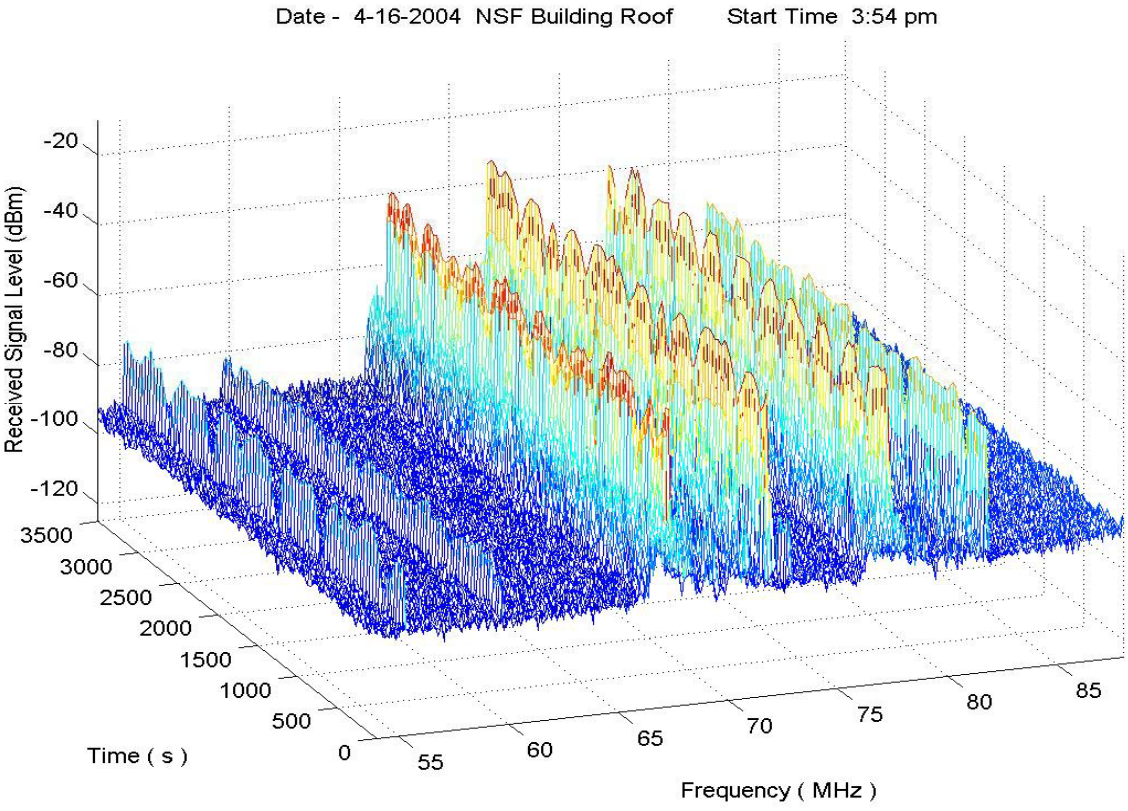
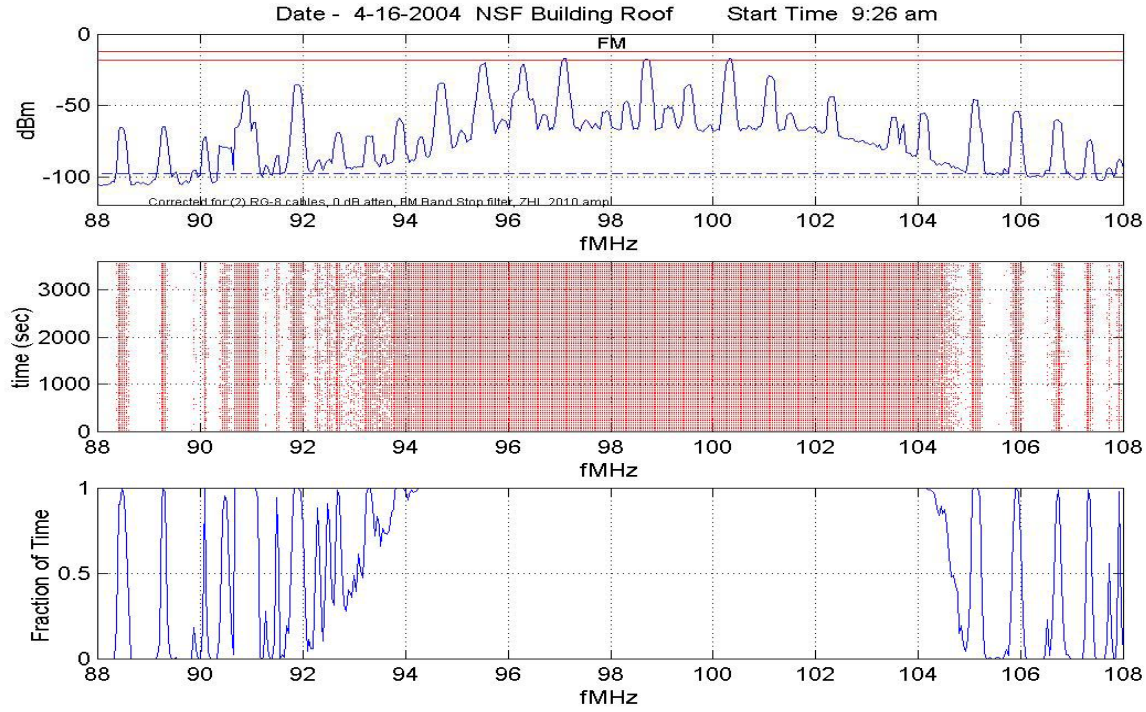


Figure 24: 54 MHz – 88 MHz (Antenna rotating, NSF, w/o Pre-amp).



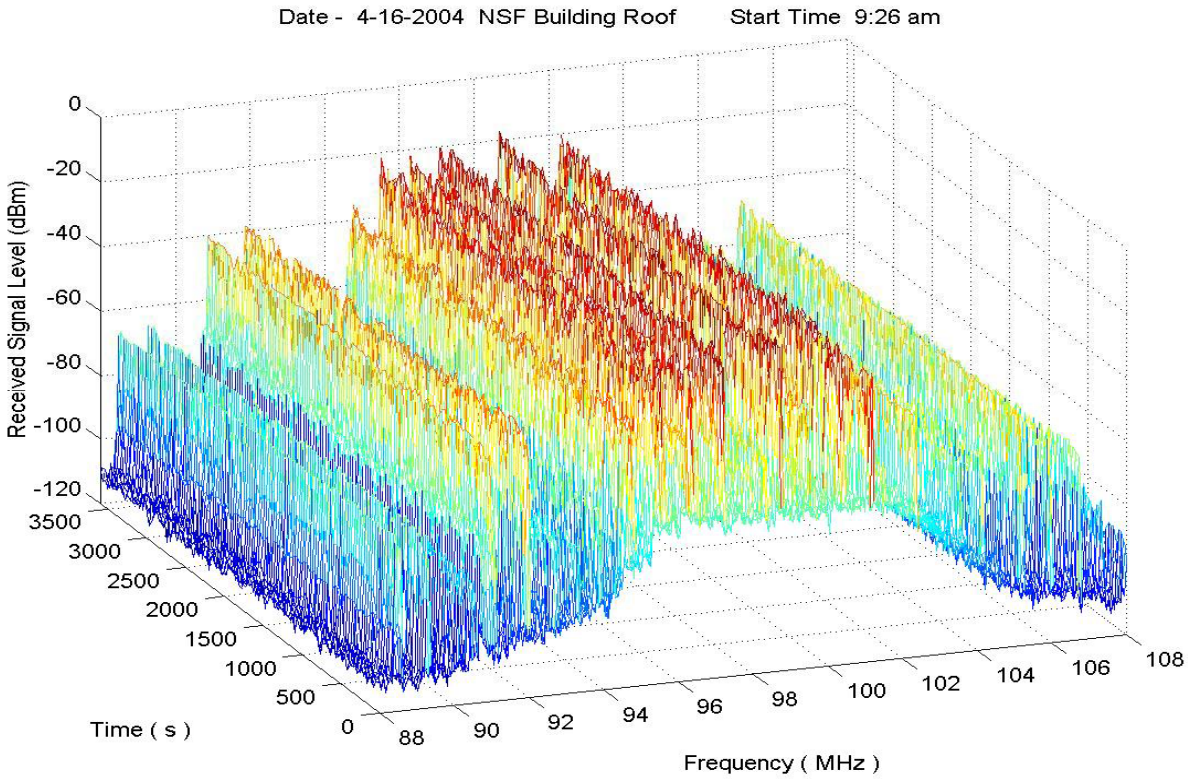
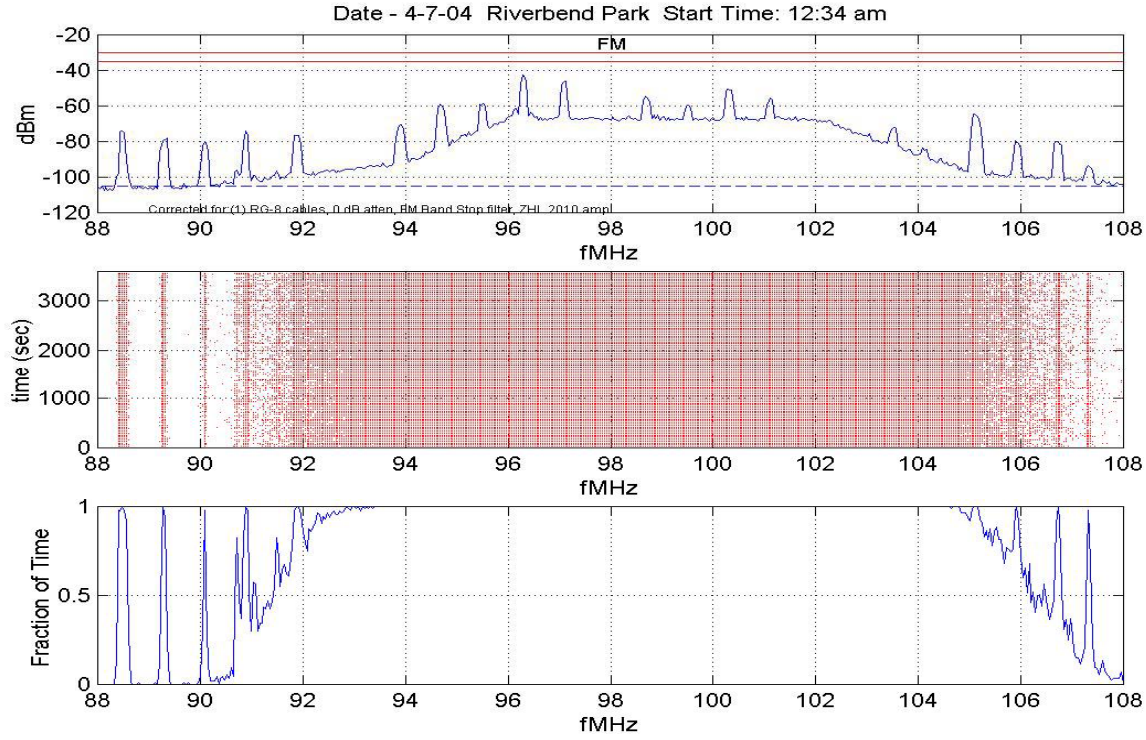


Figure 25: 88 MHz – 108 MHz (Antenna Not- Rotating, NSF).



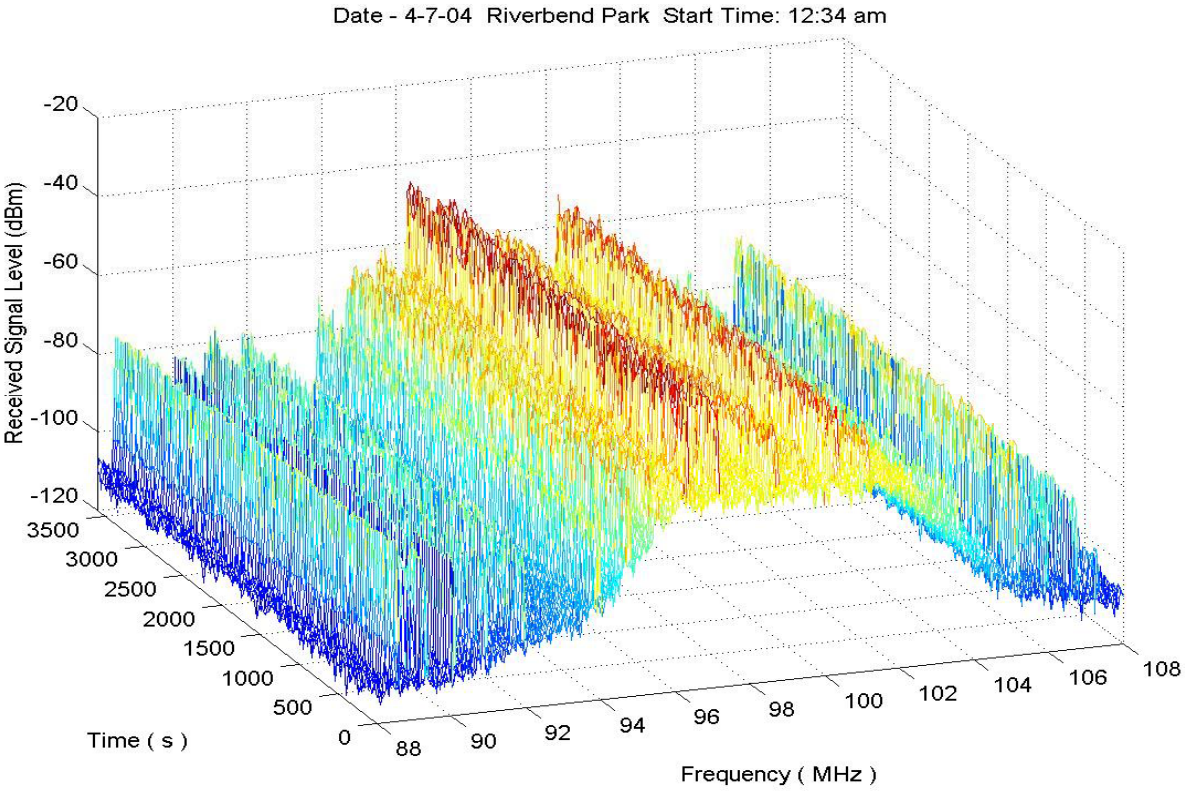


Figure 26: 88 MHz – 108 MHz (Antenna Not-Rotating, Riverbend Park).